Summary of Swedish Research Using Crash Recorder Data

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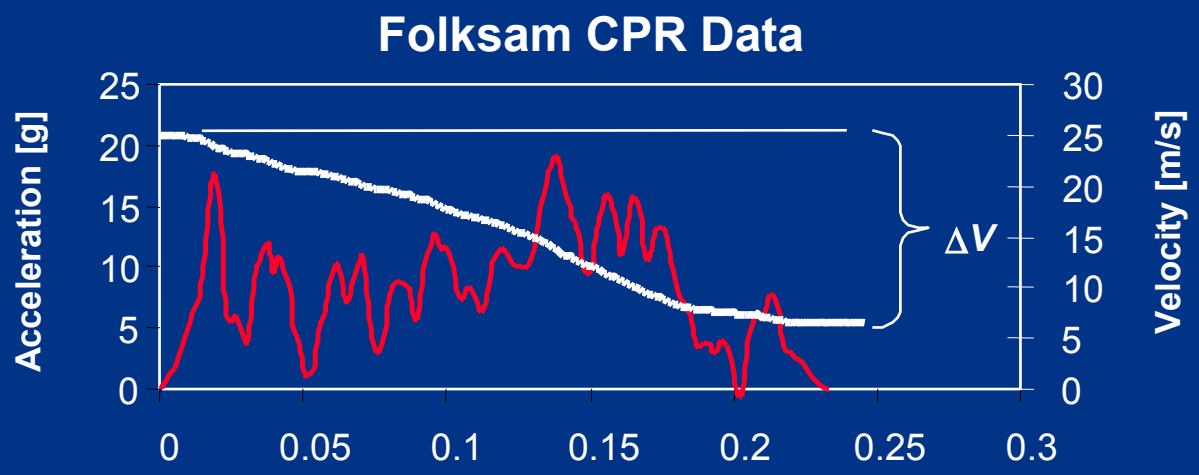
- Injury Biomechanics Research
  - Primary focus on:
    - neck injuries
    - head injuries
    - pedestrian safety

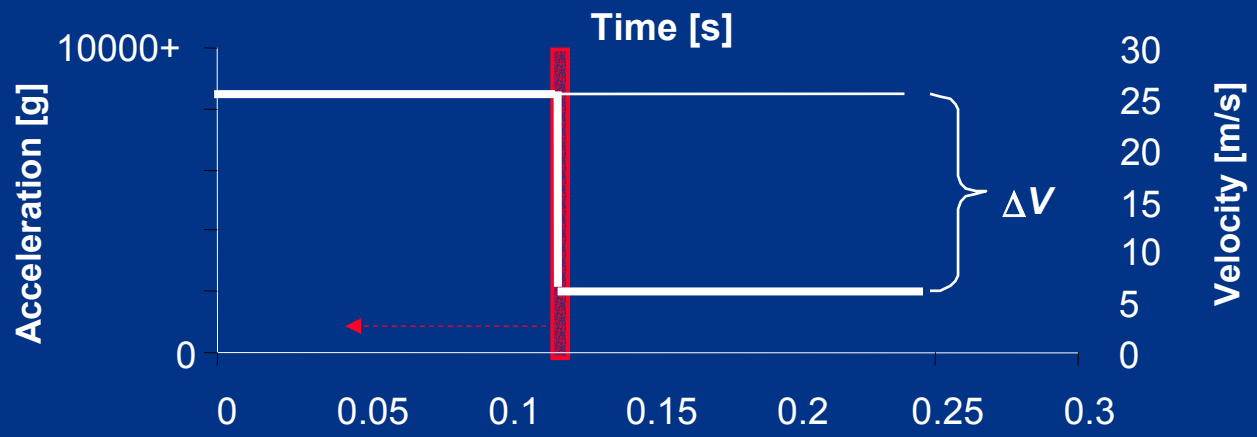
Research Tools

- Mechanical Testing
  - Including development of crash test dummies
    - BioRID: Biofidelic Rear Impact Dummy
- Computer Simulation
    - MADYMO
    - RADIOSS
    - LS-Dyna
- Accident Investigation / Reconstruction

Crash Severity



Conventional Reconstruction Methods



Crash Recorder / EDR

- Opportunity to look “inside” the crash event
- Remove one level of uncertainty in collision analysis
- Allows injury causes and injury mechanisms to be better understood

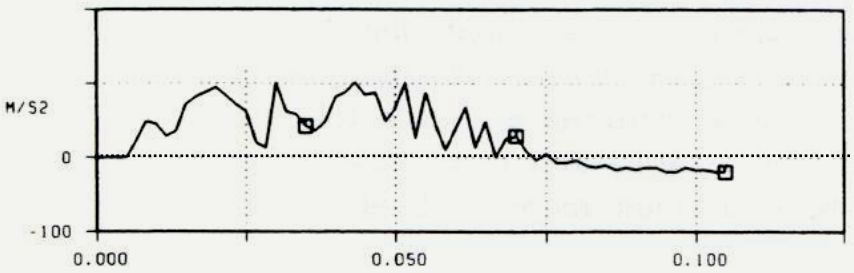
Crash Recorder Systems in Sweden

- Volvo Cars
  - Digital Accident Research Recorder (DARR)
- Saab Automobile AB
  - Crash Memory
- Folksam Research
  - Crash Pulse Recorder (CPR)

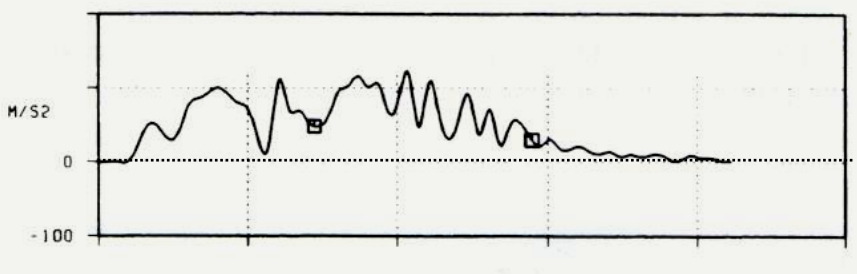
DARR

- Volvo Cars airbag sensor uses a piezo-electric accelerometer
- A recording function during the impact phase was added to the sensor in 1994
- Only Volvo Cars has access to the recorded data

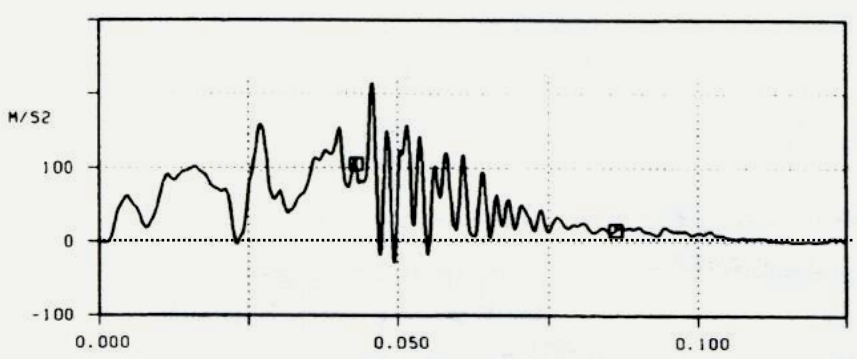
DARR Data Processing



DARR accelerometer output as recorded. Approximate locations of instants t_1 and t_2 are indicated



DARR accelerometer output after reformatting during the analysis.



Signal from a laboratory accelerometer mounted adjacent to the DARR unit.

Crash Memory

- Saab Automobile AB collects crash pulses in Sweden for internal research purposes

Crash Pulse Recorder (CPR)

- Folksam Research developed the CPR
- Since 1992, 160 000 cars have been equipped in Sweden
- Previous vehicles fitted with a CPR include Honda, Opel etc., currently installed in most new Toyota vehicles registered in Sweden

Crash Pulse Recorder (CPR)

- Innovative crash event recorder
- Motion of a spring-mass mechanism saved on photographic film
  - 3 g activation threshold
  - 1000 Hz recording rate
- Film is processed after unit is removed from vehicle

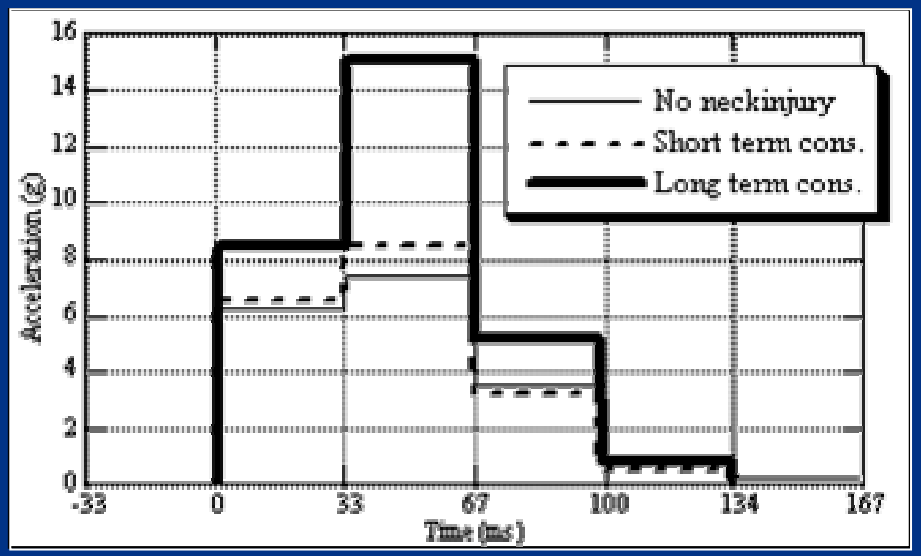
Crash Pulse Recorder (CPR)

- Accident data presented by Folksam researchers
- Cooperation with:
  - Chalmers
  - Autoliv Research
  - Swedish National Road Administration
  - …

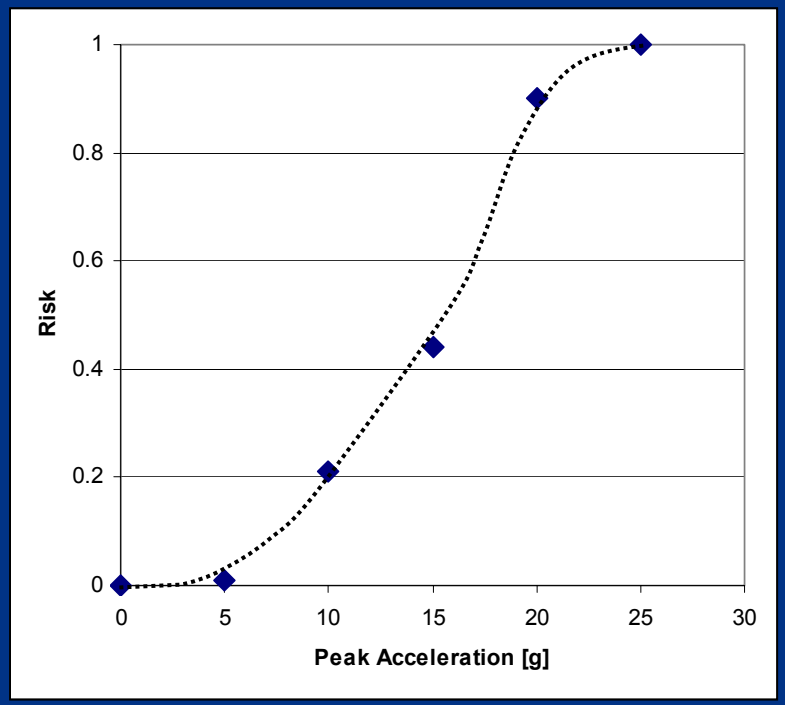
CPR Data Applications

- Grouping injury data with reliable collision severity parameters
- Analysis of crash pulse components
  - Peak and average acceleration
  - Pulse shape characteristics
    - ΔV, ΔV_{33}, ΔV_{66}, …

CPR Analyses

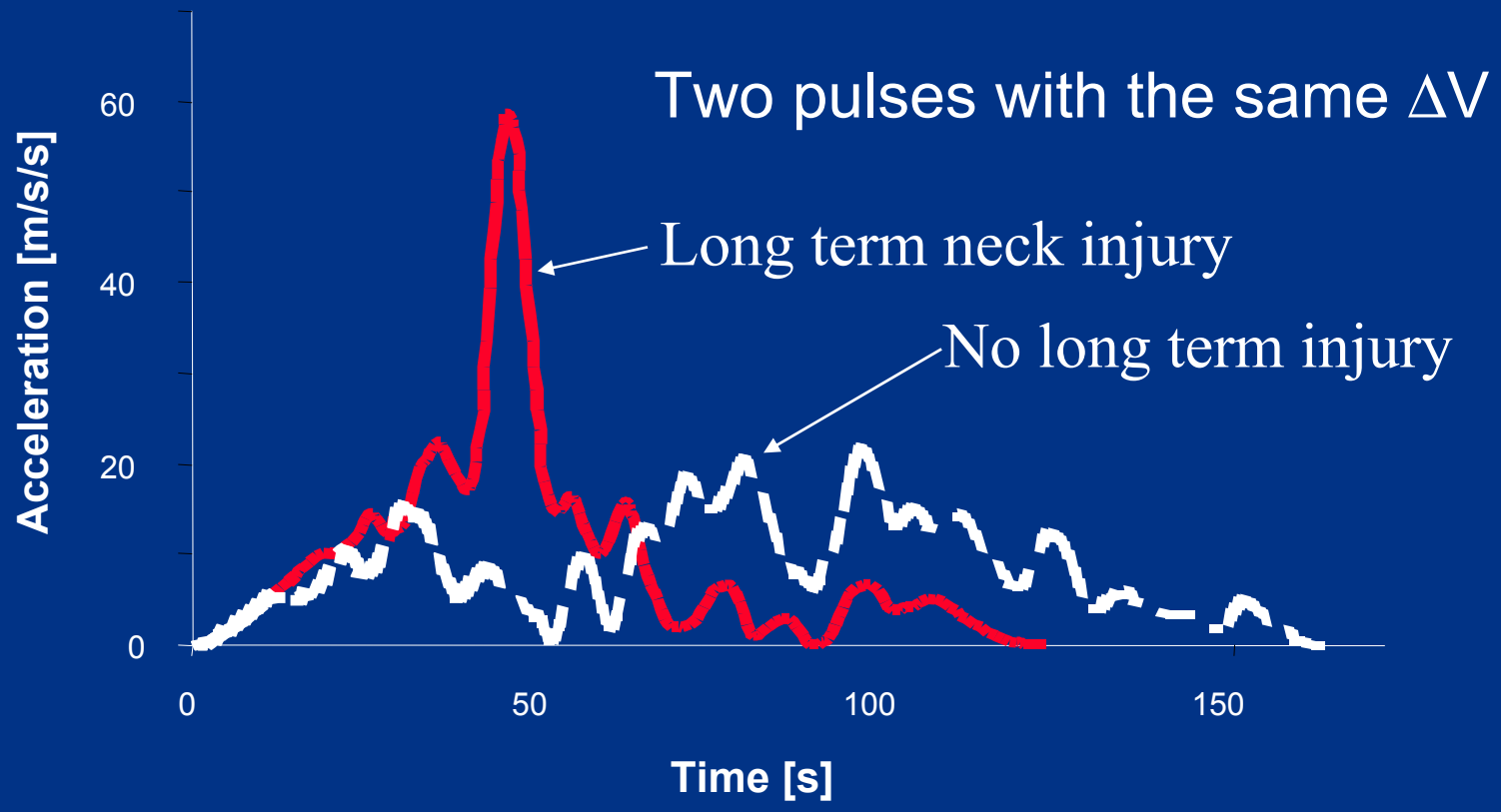


Pulse shape characteristics
to investigate injury thresholds
injury mechanisms



Injury Risk Curves
(Based on reliable
crash severity estimates)

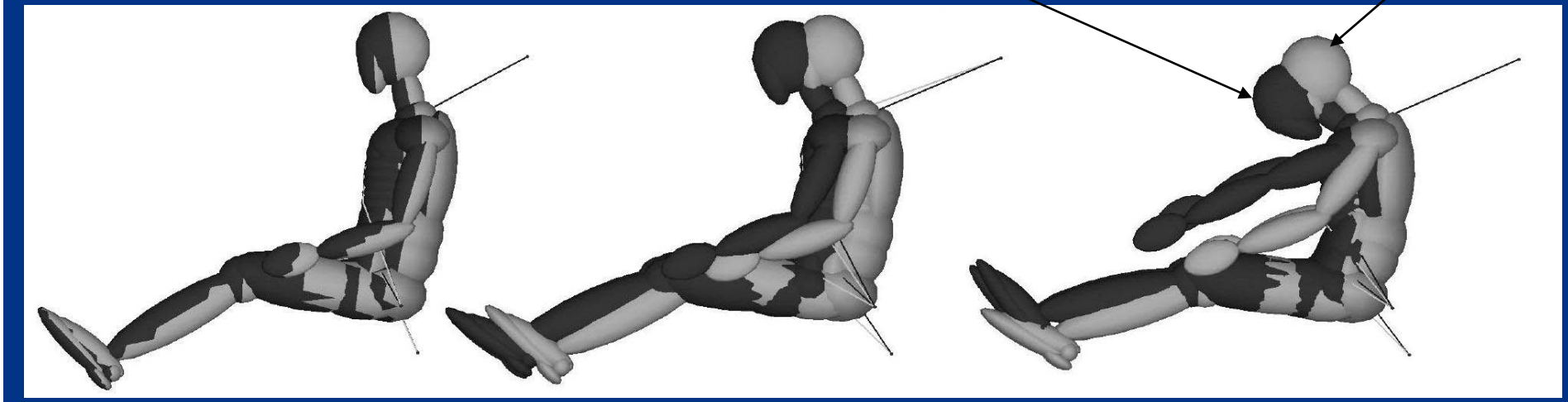
CPR Recorded Pulse Shapes



Comparison of Occupant Responses

Long term neck injury

No long term injury



Simulation based on crash pulses shown in previous slide

Results in:
The effect of crash pulse shape on AIS1 neck injuries in frontal impacts
Kullgren A, Thomson R, Krafft M
1999 IRCOBI Conference, Barcelona, Spain

CPR Applications

- Reconstruction of occupant kinematics using advanced occupant simulation codes with crash pulse data as input
- Currently used in developing an injury criterion for neck injuries
- Take advantage of the “non-volunteer” test subjects
  - Can provide data not available from biomechanical testing based on human volunteers

Potential Applications of Detailed Crash Data in Sweden

- Pre-crash data to investigate collision causation
  - Evaluation of active safety systems
- Continued accident reconstruction of occupant kinematics
- National and European Union research activities

Potential for EDR Standardisation

- Opportunity to focus research activities away from “guesswork” of injury severity measures and focus on injury biomechanics
- Better product performance
- Better rulemaking
- Safer roads!

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